

Amendment and Response

Serial No.: 10/676,324

Confirmation No.: 6481

Filed: 30 September 2003

For: PRODUCTION OF HYDROGEN FROM ALCOHOLS

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Amendments to the Claims

This listing of claims replaces all prior versions, and listings, of claims in the above-identified application:

1. (Original) A process for the production of hydrogen comprising contacting a composition comprising at least one alcohol comprising at least 2 carbon atoms with an oxygen-containing gas and a stratified catalyst under conditions effective to produce hydrogen.
2. (Original) The process of claim 1 wherein the alcohol is present in the composition in a concentration of at least about 75 weight percent, based on total weight of the composition.
3. (Original) The process of claim 1 wherein the alcohol is mixed with water.
4. (Original) The process of claim 1 wherein the process is carried out under autothermal conditions.
5. (Original) The process of claim 1 wherein the alcohol is ethanol.
6. (Original) The process of claim 1 wherein the catalyst includes a backface, and further wherein the backface of the catalyst is at a temperature of at least about 300°C after contact with the alcohol and oxygen-containing gas.
7. (Original) The process of claim 6 wherein the backface of the catalyst is at a temperature of no greater than about 1,400°C after contact with the alcohol and oxygen-containing gas.
8. (Original) The process of claim 1 wherein the residence time of the alcohol and oxygen in contact with the catalyst is no greater than about 100 milliseconds.

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9. (Original) The process of claim 1 wherein the catalyst comprises rhodium.
10. (Original) The process of claim 1 wherein the catalyst comprises rhodium metal, and/or oxide thereof, and at least one additional metal selected from the group of Groups 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14 of the Periodic Table, and combinations thereof.
11. (Original) The process of claim 10 wherein at least one metal is present in the form of an oxide.
12. (Original) The process of claim 10 wherein the additional metal comprises cerium.
13. (Original) The process of claim 1 wherein the alcohol and oxygen-containing gas are at a temperature of at least about 130°C prior to contact with the catalyst.
14. (Original) The process of claim 13 wherein the alcohol and oxygen-containing gas are at a temperature of no greater than about 160°C prior to contact with the catalyst.
15. (Original) The process of claim 1 wherein the catalyst comprises a support selected from the group consisting of metal monolith, metal foam, ceramic monolith, foam ceramic monolith, solid spheres, porous spheres, pellets, gauze, wires, plates, and combinations thereof.
16. (Original) The process of claim 1 having a gas hourly space velocity of at least about 10,000 hr⁻¹.
17. (Original) The process of claim 16 having a gas hourly space velocity of no greater than about 5,000,000 hr⁻¹.

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18. (Currently Amended) A process for the production of hydrogen comprising:
providing a feed gas comprising at least one alcohol comprising at least 2 carbon atoms;
providing a catalyst having a backface; and
contacting the feed gas with the catalyst under conditions effective to produce hydrogen;
wherein the backface of the catalyst is at a temperature of at least about 300°C after contact with the alcohol, and wherein the feed gas is supplied at a temperature of no greater than about 160°C prior to contact with the catalyst.
19. (Original) The process of claim 18 wherein the backface of the catalyst is at a temperature of no greater than about 1,400°C after contact with the alcohol and the oxygen.
20. (Original) The process of claim 18 wherein the feed gas further comprises water.
21. (Original) The process of claim 18 wherein the alcohol is ethanol.
22. (Original) The process of claim 18 wherein the catalyst comprises rhodium metal, and/or oxide thereof, and at least one additional metal selected from the group of Groups 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14 of the Periodic Table, and combinations thereof.
23. (Original) The process of claim 22 wherein at least one metal is present in the form of an oxide.
24. (Original) The process of claim 22 wherein the additional metal is cerium.
25. Cancelled

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26. (Original) The process of claim 18 wherein the gas hourly space velocity is at least about 10,000 hr⁻¹.
27. (Original) The process of claim 26 wherein the gas hourly space velocity is no greater than about 5,000,000 hr⁻¹.
28. (Currently Amended) A process for the production of hydrogen comprising:
providing a feed gas comprising at least one alcohol comprising at least 2 carbon atoms;
providing a catalyst; and
contacting the feed gas with the catalyst under conditions effective to produce hydrogen;
wherein the residence time of the feed gas over the catalyst is no greater than about 100 milliseconds, and wherein the feed gas is supplied at a temperature of no greater than about 160°C prior to contact with the catalyst.
29. (Original) The process of claim 28 wherein the feed gas further comprises water.
30. (Original) The process of claim 28 wherein the alcohol is ethanol.
31. (Original) The process of claim 28 wherein the catalyst comprises rhodium metal, and/or oxide thereof, and at least one additional metal selected from the group of Groups 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14 of the Periodic Table, and combinations thereof.
32. (Original) The process of claim 31 wherein at least one metal is present in the form of an oxide.
33. (Original) The process of claim 31 wherein the additional metal is cerium.

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34. Cancelled

35. (Currently Amended) A process for the production of hydrogen comprising:
providing a feed gas comprising at least one alcohol comprising at least 2 carbon atoms;
providing a catalyst; and
contacting the feed gas with the catalyst under conditions effective to produce hydrogen,
wherein the feed gas is supplied at a temperature of no greater than about 160°C prior to contact
with the catalyst; and wherein the overall process occurs under autothermal conditions.

36. (Original) The process of claim 35 wherein the feed gas further comprises water.

37. (Original) The process of claim 35 wherein the alcohol is ethanol.

38. (Original) The process of claim 35 wherein the catalyst comprises rhodium metal, and/or oxide thereof, and at least one additional metal selected from the group of Groups 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14 of the Periodic Table, and combinations thereof.

39. (Original) The process of claim 38 wherein at least one metal is present in the form of an oxide.

40. (Original) The process of claim 38 wherein the additional metal is cerium.

41. Cancelled

42. (Original) A process for the production of hydrogen comprising:
providing a feed gas comprising at least one alcohol comprising at least 2 carbon atoms;
providing a stratified catalyst; and

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contacting the feed gas with the stratified catalyst under conditions effective to produce hydrogen;

wherein the stratified catalyst comprises at least one first portion and at least one second portion, wherein the first portion comprises at least one metal selected from the group consisting of Groups 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14 of the Periodic Table, oxides thereof, and combinations thereof, and the second portion comprises at least one metal selected from the group of Pd, Pt, Rh, Ir, Cu, Co, Zn, V, Ag, Ni, Ce, Zr, Y, Al, oxides thereof, and combinations thereof.

43. (Original) The process of claim 42 wherein at least one metal is present in the form of an oxide.

44. (Original) The process of claim 42 wherein the feed gas further comprises water.

45. (Original) The process of claim 42 wherein the alcohol is ethanol.

46. (Original) The process of claim 42 wherein the first portion of the stratified catalyst comprises rhodium metal, and/or oxide thereof, and the second portion of the stratified catalyst comprises a metal selected from the group consisting of Pd, Pt, Rh, Ir, Ce, Zr, Al, Y, oxides thereof, and combinations thereof.

47. (Original) The process of claim 46 wherein the second portion of the stratified catalyst comprises cerium, cerium oxide, or a combination thereof.

48. (Original) The process of claim 46 wherein the second portion of the stratified catalyst comprises platinum and cerium.

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49. (Original) The process of claim 48 wherein the platinum and the cerium are each present in the stratified catalyst in an amount of 2.5 weight percent, based on total weight of the catalyst.

50. (Original) The process of claim 42 wherein the overall process takes place under autothermal conditions.